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COMPLETE SPECIFICATION

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IMPROVEMENTS IN PISCINE BASED COMPOSITIONS

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hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:

This specification relates to the incorporation of vegetable i.e. plant matter into a piscine broth, that is, to a liquid nutrient composition prepared from a feedstock comprising predominantly fish and/or fish derived matter.

BACKGROUND OF THE INVENTION

- 5 Preparations which are probably best described as liquid nutrient compositions from organic plant or animal matter have long been known. Traditionally their uses have been as nutrients, either as a feedstock for animals or as a fertiliser for plants, though many other novel uses have been proposed and implemented over the years.
- 10 Trace elements and nutrients are now known to be essential for the normal well-being and good health of humans and other animals. The normal dietary intake of most animals and humans are such that these elements and other nutrients are often supplied at the required levels. However, specific locales may exhibit a deficiency in one or more of these
- 15 nutrients. These deficiencies may be localised to a small and specific geographical area (e.g. a specific county, a specific geographical feature, a particular type of soil or even one paddock on a farm) or may affect a much larger region (for instance an entire country or continent). As an example of the latter, most New Zealand soils have been found to be deficient in the
- 20 elements Cobalt, Selenium and Iodine. As a consequence, unless remedial fertilising preparations are applied, plant life grown in these regions will also be deficient in these elements. As the next step in the food chain, animals feeding on this plant life will also fail to induce the required dietary levels of these elements unless some form of supplemental tonic is
- 25 administered. Means of addressing this problem is either indirectly - applying doses of the deficient elements to the soils which are then transferred down the food chain; or directly to the animal in the form of a

tonic. Such tonics and fertilisers, according to the present invention may take the form of liquid nutrient compositions.

The nature of liquid nutrient compositions can vary considerably and in the context of this specification, 'liquid nutrient composition' shall be

- 5 defined as being a substantially liquid product derived from a feedstock which is not necessarily liquid in nature but which may either contain or comprise in total, solid matter. By substantially liquid it is meant fluid and the term may include solutions, slurries, syrups, suspensions etc. The term liquid nutrient composition where used herein is not intended to be
- 10 indicative of the process by which the liquid nutrient composition product has been obtained.

Of the various liquid nutrient compositions known, those derived from fish and other marine matter are of the greatest interest. A known process which uses as a feedstock fish offal and other by products of the fish

- 15 industry, involves the comminution of the feedstock prior to an acid treatment where the feedstock is, essentially, digested. After this the digested mixture may be neutralised and screened to remove any remaining solid matter. While the process is reasonably efficient, a significant amount of solid waste matter still remains at the end of the
- 20 acid digestion process. Another process is known wherein the fish is subjected to one or more 'digestion' steps prior to comminution.

Other liquid nutrient compositions are known which are derived predominantly from plant matter, and in particular seaweed. However such preparations are generally based on a feedstock comprising solely

- 25 plant matter - the presence and effects of animal or fish matter is not a consideration.

NATURE & ASPECTS OF THE INVENTION

It is an object of the present invention to address the foregoing problems or at least to provide the public with a useful choice.

According to one aspect of the present invention there is provided a process

- 5 for the preparation of a liquid nutrient composition from a feedstock (as herein defined) and plant matter (as herein defined), and wherein said process comprises at least:

- treating at least the plant matter under alkaline conditions;
- treating at least the feedstock under acid conditions, and
- 10 - the combination of feedstock and plant matter.

According to a further aspect of the present invention there is provided a liquid nutrient composition, prepared according to a process substantially as described above.

According to another aspect of the present invention there is provided a

- 15 process, substantially as described above, in which said plant matter comprises material which increases the viscosity of a resulting product of the process.

According to yet a further aspect of the present invention there is provided

- a thickened liquid nutrient composition, prepared according to a process
- 20 substantially as described above.

According to yet a further aspect of the present invention there is provided a process for the preparation of a fertiliser composition comprising the addition of a diluent or carrier to a composition substantially as described above.

According to yet a further aspect of the present invention there is provided a method of fertilising comprising the application of a composition, substantially as described above, to plants or pasture.

- According to yet a further aspect of the present invention there is provided
- 5 a method for the planting of seeds comprising their dispersal in a thickened liquid nutrient composition, substantially as described above, and the subsequent application of same into the soil or seed drill.

DEFINITIONS

Where the term seaweed is used herein, it shall refer to that vegetation

10 inhabiting the sea, lakes, rivers and shoreline and which are commonly referred to as seaweed or lakeweed or riverweed. Preferred seaweeds include the kelp family and other seaweeds commonly used in the preparation of fertilisers and fertilising extracts.

Wherever used herein, acid conditions shall refer to conditions where the

15 pH is less than 7.0.

Wherever used herein, alkaline conditions shall refer to conditions wherein the pH exceeds 7.0.

Wherever used herein, the term substantially neutral shall refer to a condition wherein the pH exceeds 5.5 and is less than 8.5.

20 Piscine oil, as used within this specification, shall refer to an oil derived from fish or from fish matter. Also included are oils derived from marine cetaceans. Typically, though not necessarily, the oils used shall be a by-product from fish processing processes. The oil derived from the process described herein has been found to be particularly suitable.

Wherever used herein, the term 'elemental fertiliser source' shall refer to a compound or product of either organic or inorganic origin which is rich in the plant available element in question. It is envisaged that a single elemental fertiliser source may be rich in more than one element. The 5 following examples are given by way of illustration and it should be realised that the scope and use of the present invention need not necessarily be restricted to the use of the components listed below (e.g. any commonly used or known fertilising nutrient could be used in addition or in substitution):

10	Nitrogen	Urea, nitrates, ammonium compounds
	Potassium	Potassium compounds, including the nitrate and sulphate
	Phosphorous	Phosphates, superphosphate, other phosphorous compounds
15	Sulphur	Superphosphate, sulphates, elemental sulphur, sulphides, sulphites and other sulphur containing compounds
	Calcium	Chalk, dolomite, bones, other calcium compounds
	Magnesium	Magnesium sulphate, other magnesium compounds
20	Sodium	Sodium nitrate, other sodium compounds
	Boron	Coal fly ash, boron containing timber treatments, borates, boric acid
	Iron	Iron sulphate and other iron compounds
25	Other Trace Elements	These may be provided in either a chelated form or as compounds containing the element in question.

It is also envisaged that multi-elemental fertiliser sources may also be used, such as the commonly used blood and bone, seaweed extracts, plant derived liquid nutrient compositions and extracts etc.

THE PROCESS

5 Feedstock

- As the feedstock for the process of the present invention, it is envisaged that a majority of the feedstock is fish or fish derived matter. Typically the feedstock will comprise in its entirety fish matter such as fish offal and waste from a fish processing plant, as well as fish species not generally considered acceptable for human consumption or in the production of pet food. The species of fish is not particularly relevant and the process has been found suitable for all species of fish tried to date. Orange Roughy which was used predominantly in the trials has been found to be suitable. Cardinal, another deep-sea fish, is also acceptable.
- 15 The feedstock may also contain other matter such as animal offal, plant matter (such as seaweed etc.) and other marine life (e.g. cetaceans, molluscs, crustaceans etc.) though it is noted that the process steps given herein have been optimised for a feedstock comprising totally fish or marine derived matter. It is therefore envisaged that the feedstock for any 20 process described herein shall comprise predominantly such fish or marine derived matter, i.e. more than 50% (apart from any added solvents or diluents). It may also be desirable to add to the feedstock elemental fertiliser sources prior to the ensuing process steps. However, these are often added to the resulting preparation.
- 25 Materials which are preferably absent in the feedstock are solid matter unlikely to be affected by any process steps prior to comminution and

which may damage or hinder the machinery used for comminution. An example of one such material is shark skin and it is best that this is not allowed to enter the initial feedstock. If necessary, the feedstock maybe subjected to an initial step which ensures that any such indigestible or 5 potentially damaging matter is removed before any comminution step is encountered. Many processes for screening out undesirable matter such as stones etc. are known though the added expense of such a step is not generally justified unless the source and quality of the feedstock cannot be guaranteed.

10 Alkaline Treatment

For a process wherein the feedstock is subjected to alkaline treatment, generally the first step involves said treatment of the feedstock under alkaline conditions. An alkaline agent such as potassium hydroxide is added to the feedstock and blended in. Other alkaline compounds such as 15 sodium hydroxide, alkali metal and alkaline earth metal oxides, hydroxides and carbonates could also be used (for example). Potassium hydroxide is generally preferred over sodium hydroxide for producing fertiliser preparations as potassium is one of the recognised four main fertiliser elements. The hydroxides are also generally preferred over the 20 carbonates and hydrogen carbonates as the latter are generally unable to achieve a high enough pH as well requiring the addition of too great a quantity of the reactant. These other compounds may however still be used and mixtures could also be employed.

Typically a solution of the alkaline compound(s) is prepared and this 25 solution is added to the feedstock rather than adding dry solid matter to the reaction mix. For instance, a solution of 50% potassium hydroxide is prepared and added to the feedstock so that the ratio of potassium

hydroxide present in the reaction mixture exceeds 0% and is less than or equal to 10%.

The timing of the addition of the alkaline agent to the feedstock is also important. Fish matter typically contains a high proportion of amino- and

- 5 ammonium compounds which may release ammonia gas under alkaline conditions. The rate of release of any ammonia, while dependent upon the feedstock, is also dependent upon the pH of the reaction mixture. It has been found where potassium hydroxide has been used to create an alkaline state, it is preferable that the initial quantity of potassium hydroxide
- 10 present is in the vicinity of 0.5%-1.0% (by weight) of the total vat contents.

Addition of Plant Matter & Considerations for Alkaline Treatment

In those embodiments of the present invention where plant matter is to be incorporated, it is often added to the feedstock at this stage. However there is provision for considerable variation in the manner and timing of when

- 15 and how the plant matter can be added.

For instance, in one embodiment, the plant matter may be added to the feedstock, after its alkaline treatment, and prior to comminution.

In another embodiment, the plant matter may be added and blended to the feedstock prior to its treatment under alkaline conditions. Thus both

- 20 feedstock and plant matter are subjected to some alkaline treatment.

In another embodiment, the plant matter is subjected to alkaline conditions separately from the feedstock. Any one of the alkaline compounds suitable for the feedstock may also be used for treatment of the

- 25 plant matter, though it is envisaged in most applications that potassium hydroxide may be used. This may be added in the same manner as for its addition to the feedstock. As the release of ammonia gas is not a problem,

as it were for the feedstock, a higher concentration of potassium hydroxide (or other alkaline material) may be present. For instance, the amount of potassium hydroxide added may be between 0% and 80% (by weight of potassium hydroxide present in the plant matter reaction mixture). In

- 5 practice however, to minimise costs, the concentration of potassium hydroxide present is generally in the vicinity of 0.5% - 1.0%. It is also noted that the mixture may be left to react for a longer period than for the feedstock. Typically the reaction time will exceed two minutes.

Any such treated plant matter may be added to the feedstock immediately

- 10 prior to comminution or during comminution. In other embodiments it may be blended with the feedstock and used as the means by which alkali is introduced to the feedstock. In this particular embodiment, the amount of alkaline present in the plant matter treatment may be increased such that after blending of same with the feedstock, the desired alkaline ratio
15 (e.g. 0.5%-1.0% by weight) and alkaline pH is achieved.

It is also envisaged that plant matter may be comminuted separately to the feedstock and blended with same after the comminution step. Alternatively the plant matter may be pre-commminuted before its addition to the feedstock prior to feedstock comminution.

- 20 Once an alkaline state has been created, it is desirable to proceed to at least the next step of the process within a short period lest the quantity of ammonia released from reaction of the feedstock creates its own problems requiring the installation of expensive gas-evacuation plant machinery. For a feedstock which is predominantly Orange Roughy or Cardinal, and
25 wherein the potassium hydroxide concentration initially present is in the vicinity of 0.5%-1.0% by weight, it is generally desirable to allow the

mixture to react for less than 5 minutes before proceeding to the next step in the process.

Comminution

In the preferred embodiment of the present invention, the reaction mixture is forwarded to a comminution step after an average reaction time of approximately 30 seconds. This comminution step, in the preferred embodiment comprises two sub-steps. The first sub-step comprises a crushing or mincing step wherein the particles are broken down to a size more acceptable for the machinery of the second sub-step which involves cutting or fine comminution of the reaction mixture. In a preferred embodiment, the initial crushing sub-step is performed by a HOBART Manufacturing Company (of Troy, Ohio, USA) brand model No. 4356-G mincer to pre-break the reaction mixture for an Urschel Laboratories Inc. brand, model No. 3600 cutter which reduces the maximum particle size in the reaction mixture to less than approximately 5-10mm, and more preferably, less than 5mm.

In other embodiments of the present invention, it is possible that the two sub-steps are combined into one. This to a large extent will depend upon the available plant machinery. The applicant has found that the use of two separate machines to achieve an initial coarse and subsequent finer comminution are satisfactory in breaking the reaction mixture down to have a maximum particle size in the vicinity of 5mm or less.

The main requirement of the comminution step is the reduction of the maximum particle size. While 5mm is the preferred maximum particle size after comminution, a greater or lesser dimension may also be employed, for instance up to 20mm. However the greater the particle size, then the slower the subsequent acid treatment. 5mm has been found to be

an acceptable size - smaller particle sizes are preferred though increase the requirements of the comminution plant equipment and the running costs of same.

- It is also noted that it is possible to perform the comminution step prior to
5 any alkaline treatment step. It is also possible in other embodiments to have several comminution steps e.g. before and after any alkaline treatment step.

Acid Treatment

- Another step in the process is an acid treatment step which is subsequent
10 to any alkaline treatment step, and in the preferred embodiment of the present invention, occurs immediately after comminution following said alkaline treatment step.

- In the acid treatment step, the pH of the reaction mixture is lowered until an acidic condition is reached. Preferably, the pH is adjusted to around pH
15 3.5. Virtually any acidic compound or mixture may be employed though sulphuric acid (2%) has been found to be suitable and commercially viable.

- The reaction mixture is allowed to remain in the acidic state until said reaction mixture is substantially liquefied. The degree of liquidisation is largely a matter of user choice. To increase the throughput for the
20 process, a shorter period of time may be used and any unliquefied solid matter removed and either discarded or reused as feedstock. Typically for when sulphuric acid is added to achieve a pH of 3.5, the period for which the reaction mixture remains in the acidic state is approximately 3 weeks. It is also desirable that the mixture is agitated periodically, for instance
25 every 3 - 4 days.

The nature and quantity of plant matter present also has a bearing on the length of time required in the acid treatment step. Many plant materials, especially seaweed, increase the viscosity of the reaction mixture. This may be considerable, even to the extent that a gel or paste is achieved. In 5 such instances it may be desirable to increase the agitation of the reaction mixture. It is also noted, that in such higher viscosity mixtures, any oil may have a lesser tendency to separate out of the mixture. Thus where it is desirable to recover or remove oil from the reaction mixture, the viscosity of the reaction mixture should be kept to lower levels. Where it is 10 desirable to contain the oil, plant matter which increases the viscosity should be employed. Separation and removal of the oil will be discussed in greater detail later.

At the end of the acid treatment step, the product liquid nutrient composition is attained. This may be further modified through the 15 incorporation of additional and optional steps into the process.

Optional Separation Steps - Oils

For instance, for certain fish such as Orange Roughy, or Cardinal, a large amount of oil separates from the reaction mixture. This may be separated via decanting, skimming, siphoning or any other acceptable means, to 20 yield a liquid nutrient composition and oil product. The oil may be discarded or sold as a by product; such oils are finding increasing use and applications in other fields. To facilitate separation of the oil, it is preferable to allow the reaction mixture to stand without agitation for at least several days. Furthermore, it generally desirable to include any such 25 oil separation step during or at the end of the acid treatment step. This does not however preclude the use of an oil separation step at any other

stage of the overall process (perhaps before the addition of any plant matter) or the use of several such oil separation steps.

According to the intended end use of the crude separated oil product, it may be further refined through additional washing, screening or 5 separation processes. Techniques for the purification and cleaning or oil as well as the separation into different fractions (if desired) are well known.

According to the end use of the liquid nutrient composition or derived preparation, it may also be desirable not to remove the oil. In viscous 10 embodiments of the present invention, there may be less tendency for any oils to separate out. Where the resulting preparation is to find use as a tonic, for instance for stock, the oil represents a source of vitamins and may be advantageously left in the preparation. Agitation of preparations stored for any length of time may be required before use or dispensing.

15 Optional Separation Steps - Large Insoluble Matter

Another optional step in the process is the screening out of any unwanted particular or solid matter. Typically this may be performed by a cylindrical screen tumbler though any other suitable method may also be used. For the preferred embodiment of the process described above, there 20 is surprisingly little waste removed. For previously known processes which did not include an alkaline treatment step prior to acid treatment, approximately 15 times the weight of unusable solid matter was removed at the final screening process. In the process of the preferred embodiment, a considerable amount of the formerly unusable material is present in a 25 fine enough form to be present either as a suspension or mild slurry.

Optional Additive Steps - Inorganic Fertiliser Sources

As a further optional step in the process, at least one additional elemental fertiliser source (as previously defined) can be added to the product liquid nutrient composition. Generally these are added to overcome a recognised

5 deficiency of any nutrient in the product liquid nutrient composition.

Alternatively, it is possible to increase the levels of specific elements when it is desired to produce a liquid nutrient composition meeting or exceeding certain requirements. Where the liquid nutrient composition is to be used as a fertiliser, the levels of specific elements and nutrients may be

10 increased to address any deficiencies in the pasture or plantation to which the fertiliser will be eventually applied. The nature of the added fertiliser sources need not be such that they are liquid or will dissolve in the liquid nutrient composition as it may be acceptable that the added fertiliser sources exist either as a suspension or slurry in the liquid nutrient

15 composition. This may be more acceptable where the prepared liquid nutrient composition (before the addition of any inorganic fertiliser elements) is a gel or viscous fluid - such as through the addition of plant matter as previously discussed.

Acceptability of solid material in the liquid nutrient composition will also

20 depend upon the use of the resulting preparation. If the product is to be used as a fertiliser then the method of application of such a composition will be a consideration. For instance it may be acceptable to transform the liquid nutrient composition into a paste through the addition of such additional fertiliser sources, the resulting paste either being applied
25 directly as a fertiliser or diluted through the use of the carrier.

REFINEMENTS & MODIFICATIONS TO THE PROCESS

pH

Refinements to the process may be made to improve the efficiency of any or all of the steps thereof. For instance it is generally known that increasing

- 5 the concentration of any of the active reagents will normally increase the rate of reaction. Hence, for the alkaline treatment step where it is desirable that any reaction is not too vigorous (due to the release of ammonia) it may be desirable to decrease the concentration of the added alkaline material, i.e. decrease the initial pH. Alternatively, for the acid
- 10 treatment step which represents the greatest period in the overall process, it may be desirable to increase the acidity of the reaction mixture.

Temperature

It has also been found that increasing the temperature of each or every step also increases the rate of reaction. Generally the temperature is

- 15 increased above ambience though it is preferable not to exceed 50°C unless modification to plant machinery is undertaken. It has been found that maintaining the reaction mixture at 25°C usefully increases the rate of reaction without requiring modification to standard equipment, excessive heating costs or increasing the rate of any reaction to uncontrollable levels.

Batch & Flow Processing

While the process has been described essentially as a batch process to more clearly define each step in the process, it is envisaged that the process will to a large extent be run as a continuous flow process. For instance, feedstock may be continually added to an initial holding tank to

- 25 which alkaline is added at a rate corresponding to the incoming feedstock.

Depending on the particular embodiment, addition of the plant matter may also be adapted to allow the overall process to be run as a continuous flow process. Typically the reaction mixture is continually blended. From here is drawn off the reaction mixture to the comminution step. The 5 configuration of the initial holding tank assembly can be set up so that the reaction mixture is drawn off after having been allowed to react for an average time of 30 seconds (or other prescribed period). Standard plant design techniques can be employed to implement such a solution.

Comminution

10 The comminution step is essentially a continuous process, depending upon the machinery. From here the reaction mixture may be directed into various holding tanks. Due to the greater period of time required for the acid treatment stage, this step in the process will generally remain a batch oriented step. However, the design of the overall plant, for instance 15 through the direction of comminuted reaction mixture to various holding tanks which are drawn from in turn, will allow this batch step to interface with the previous flow-type steps.

Carriers, Diluents & Viscosity - Suitability for Different Applications

20 While the product liquid nutrient composition obtained from such a process may find a wide number of applications, it is envisaged that a primary use of such liquid nutrient composition is as a fertiliser for use with plants or bacteria and the present invention also provides for such fertilising compositions derived from the liquid nutrient composition of the process. Another primary use is as, or as the basis of, a preparation 25 administered to animals (predominantly farmed stock) as a tonic and to counter vitamin and/or mineral deficiencies.

When used for fertiliser applications, the liquid nutrient composition may be used unmodified. Where the liquid nutrient composition is to be applied to a pasture or plantation the undiluted liquid nutrient composition may be applied directly. This will usually depend upon the ability of the applicator

5 generally spray application is used) to apply the liquid nutrient composition at the required rate. More usually, the liquid nutrient composition is diluted with an acceptable carrier or diluent to produce a fertilising composition. This is especially true when the viscosity of the liquid nutrient composition has been increased through the addition of

10 plant matter.

It may, though, be desirable to use liquid nutrient compositions (or modified liquid nutrient compositions) whose viscosity is such that they are gels or pastes. This may be because of various commercial advantages, such as easier dispensing and dosage, easier packaging, less tendency for

15 components to separate out upon storage, greater stability for product or whatever other reason which may depend upon the nature of the components therein. Some of these modifications may also be advantageous for non-fertilising applications including for in preparations administrable to animals.

20 By the term 'acceptable', it is preferred that the carrier or diluent is compatible with the liquid nutrient composition and/or any additional components which have been incorporated therein. The problems which we are trying to avoid is that of degradation of the composition during storage or before application, as well as avoiding any reaction which locks

25 various nutrients up so as to make them unavailable for plants or animals (depending on the application). Typically the carrier or diluent will be water though an aqueous solution of other additives (for instance lubricating/anti-corrosive additives for the application machinery) may

also be added. It is envisaged that carriers and diluents other than water or aqueous solutions may also be used.

Paste and gel like preparations may find applications without the use of carriers or diluents. For instance it is known to use gels as a carrier for 5 seeds during the sowing thereof. Some gels according to the present invention may find application in this area. Pastes and gels may be applied via a drench gun or caulking gun type arrangement around shrubs or between rows of plants. The increasing of the viscosity of the otherwise unmodified piscine liquid nutrient composition, through the 10 addition of plant matter, increases the range of possible applications for the product. Other than some of the illustrative examples discussed herein, these applications will not be discussed further.

APPLICATIONS OF THE LIQUID NUTRIENT COMPOSITION

Fertilisers

15 Typically a fertilising composition will comprise between 0.01% - 99.99% of a liquid nutrient composition prepared by a process as before described to which is added an acceptable carrier or diluent to make the composition up to a total of 100%.

Alternatively, the fertilising composition may comprise between 0.01% - 20 99.99% of a liquid nutrient composition which comprises a blend of one or more liquid nutrient compositions prepared by a process substantially as before described and to which is added an acceptable carrier or diluent to make the composition up to a total of 100%. Each of the liquid nutrient compositions may be made by a process (substantially as before described) 25 which includes plant matter, or may also be a liquid nutrient composition which is prepared by substantially the same process but without the

addition of plant matter. Through the blending of different liquid nutrient compositions having different properties, preparations having custom tailored parameters, such as viscosity, nutrient levels etc., may be made according to user preference.

- 5 Alternatively, additional elemental fertiliser sources may also be incorporated into the composition. This may be in addition to those which may have been added earlier. One instance where it may be desirable to add additional elemental fertiliser sources at this stage is where said fertiliser sources have a tendency to degrade or become inactive during
- 10 storage of a fertilising composition such as described or of the undiluted liquid nutrient composition. In such a case the fertilising composition may be provided in at least two parts to be combined prior to use. The diluent or carrier may be added before or after the various parts are mixed together. Such a situation however is rare and generally a fertiliser
- 15 composition containing additional elemental fertiliser sources will be prepared by adding said fertiliser sources to the liquid nutrient composition and combining with a carrier or diluent to yield the final composition. Typically the proportions will be 0.01% - 99.9% of a liquid nutrient composition (or blend) prepared by a process substantially as
- 20 before described, 0.001% - 50% in total of at least one additional one elemental fertiliser source, as previously defined, and a carrier or diluent compatible with the other components to yield a composition whose components total 100%.

It has also been mentioned that a step may be provided in the process
25 whereby oil may be separated from the liquid nutrient composition. Such a step is considered to be more likely where the feedstock comprises a significant proportion of deep-sea fish, especially Orange Roughy or Cardinal. These two fish have high oil contents, the oils themselves being

a valuable commercial product. In this regard it is generally preferable to separate out the oil as firstly the recovered oil may be sold or used in other processes, and secondly, it is generally undesirable to use a liquid nutrient composition having a significant oil content (unless it has been stabilised - perhaps through the formation of a gel or paste) liable to separate out upon standing. This however does not preclude the use of liquid nutrient compositions whose oil content has not been separated out, in the preparation of fertilising compositions and in some cases this may be preferable as the oil content may act as a lubricant for any spray or application machinery.

DESCRIPTION & EXAMPLES OF VARIOUS EMBODIMENTS

Further aspects of the present invention will now be described in greater detail with reference to a preferred embodiment of the present invention.

It should be appreciated that the scope of the present invention need not be limited to said ensuing description.

THE PROCESS

Two preferred embodiments of a process according to the present invention are as follows:

Example 1 - No Additional Plant Matter

A feedstock comprising a predominantly or exclusively Orange Roughy is used. The feedstock is typically the waste from a fish processing plant.

The feedstock is collected in a large holding tank having screw auger to enable mixing of the contents. On a typical production scale, the holding tank is sufficiently large to hold one to two tonne of feedstock.

- A 50% solution of potassium hydroxide is prepared. This is added to and blended with the feedstock in the tank. The quantity of potassium hydroxide solution added is such that typically the potassium hydroxide will represent 0.5 - 1.0% by weight of the total vat contents. For instance, 20
- 5 litres of 50% potassium hydroxide solution is added to two tonne of feedstock.

- The reaction mixture is blended for approximately 30 seconds before being fed through a HOBART model 4356-G mincer to pre-break the reaction mixture. The output from the HOBART mincer is immediately fed into an
- 10 Urschel Laboratories model 3600 cutter where the maximum particle size is reduced to less than approximately 5mm.

Following the initial alkaline treatment and comminution steps, a reasonable amount of liquid is now present.

- The output from the comminution step is then fed into a 'D' vat with a
- 15 mixer enabling agitation of the contents. The reaction mixture is now acidified through use of sulphuric acid (normally a 2% solution) until the pH is approximately 3.5. The reaction mixture is held within the 'D' vat for approximately three weeks with agitation occurring every 3 - 4 days. If necessary, additional sulphuric acid may be added to maintain the pH in
- 20 the vicinity of 3.5. Normally this would be added immediately prior to any agitation.

- At the end of the acid treatment period, the oil may be separated. Preferably there has been no agitation for at least 3 - 4 days prior to oil removal so that the majority of oil has risen to form a discrete layer above
- 25 the liquid nutrient composition. The oil may then be removed by decanting, siphoning or scooping it off with a bucket.

The collected oil may then be screened and washed if desired.

The remaining liquid nutrient composition is then screened through a fine mesh to remove any remaining solid matter. Typically this is through a cylindrical screen with rotating paddles inside.

- 5 The filtered product now comprises a fluid comprising typically 24% solid matter present as a suspension (though it is noted that this may not be a true suspension and solid matter settle after a long period of time). The thus obtained base product or liquid nutrient composition may then be used as a final product or further modified to produce various
- 10 compositions and preparations.

Example 2 - Added Plant Matter

A feedstock comprising a predominantly or exclusively Orange Roughy or Cardinal is used. The feedstock is typically the waste from a fish processing plant.

- 15 The feedstock is collected in a large holding tank having screw auger to enable mixing of the contents. On a typical production scale, the holding tank is sufficiently large to hold one to two tonne of feedstock.

- 20 A 50% solution of potassium hydroxide is prepared. This is added to and blended with the 40kg of seaweed before being blended with feedstock in the tank. The quantity of potassium hydroxide solution added is such that typically the potassium hydroxide will represent 0.5 - 1.0% by weight of the total vat contents, once the reagents have been combined. For instance, 20 litres of 50% potassium hydroxide solution is added to 40kg of seaweed for use with a total of two tonne of feedstock.

The seaweed may be shredded, cut or chopped before being blended with the potassium hydroxide though this is not essential due to subsequent comminution steps. The choice of seaweed is not essential, and any commercially available seaweed may be selected according to the market.

- 5 If necessary, different varieties of seaweed may be blended or used to alter the ratios of elements in the mixture, though these are perhaps better altered through addition of inorganic fertilising components unless the required alterations are only minor in nature or an absence of inorganic fertilising elements is required.
- 10 Typically, a kelp such as commonly found on New Zealand shorelines is used. The spread of elements in this seaweed tends to be the inverse of the spread of elements in the fish-based raw material so that between the two a more balanced spread of elements often results than is possible by either using solely fish matter or seaweed. However, geographical variations in raw materials sources will also yield raw materials of differing elemental proportions and amounts.
- 15

The incorporation of 20kg of seaweed per tonne of fish matter yields a final product whose viscosity resembles that of a thin wall-paper paste. The increased viscosity helps to prevent the separation or settling of solid components in the final product over time.

- 20
- 25 The entire reaction mixture is blended for approximately 30 seconds before being fed through a HOBART model No. 4356-G mincer to pre-break the reaction mixture. The output from the HOBART mincer is immediately fed into an Urschel model No. 3600 cutter where the maximum particle size is reduced to less than approximately 5mm.

Following the initial alkaline treatment and comminution steps, a reasonable amount of liquid is now present.

- The output from the comminution step is then fed into a 'D' vat with a mixer enabling agitation of the contents. The reaction mixture is now acidified through use of sulphuric acid (normally a 2% solution) until the pH is approximately 3.5. The reaction mixture is held within the 'D' vat
- 5 for approximately three weeks with agitation occurring every 3 - 4 days. If necessary, additional sulphuric acid may be added to maintain the pH in the vicinity of 3.5. Normally this would be added immediately prior to any agitation.

At the end of the acid treatment period, the oil may be separated.

- 10 Preferably there has been no agitation for at least 3 - 4 days prior to oil removal so that a reasonable proportion of oil has risen to form a discrete layer above the liquid nutrient composition. The oil may then be removed by decanting, siphoning or scooping it off with a bucket.

The collected oil may then be screened and washed if desired.

- 15 The remaining liquid nutrient composition is then screened through a fine mesh to remove any remaining solid matter. Typically this is through a cylindrical screen with rotating paddles inside.

The filtered product now comprises a fluid comprising typically 20% - 40% solid matter present as a suspension (though it is noted that this may not

- 20 be a true suspension and solid matter settle after a long period of time). The thus obtained base product or liquid nutrient composition may then be used as a final product or further modified to produce various compositions and preparations.

Typical Analysis of Liquid nutrient composition

- 25 As an example of the typical elemental composition of a base product prepared by the foregoing process, are the typical analysis in Table 1. Due

to variations in the nature of the feedstock and plant matter, these values may vary and should be treated as being only representative of a typical production run.

	Nitrogen	1.7%	Boron	0.1 ppm
5	Phosphorus	0.59%	Iron	345 ppm
	Potassium	0.15%	Manganese	3 ppm
	Calcium	0.93%	Copper	2 ppm
	Magnesium	0.02%	Zinc	17 ppm
	Sodium	0.15%	Molybdenum	0.02 ppm
10	Sulphur	0.01%	Cobalt	0.05 ppm
	Iodine	1.75 ppm	Selenium	0.94 ppm

TABLE 1

- Additional elemental fertiliser components, inorganic and/or organo-metallic compounds may be added to the liquid nutrient composition to
- 15 increase the levels of specifically selected elements. There is no general restriction as to the manner in which the levels of any element are increased other than any added component should be compatible with the liquid nutrient composition. For instance, it would not be advisable to increase the potassium level through the addition of potassium hydroxide
- 20 as this may promote ammonia release, especially if added substances included ammonium compounds (refer also alkaline treatment step). Such effects are well known and the base product may be 'fortified' through the addition of compounds and mixtures commonly used as fertilisers or animal pharmaceuticals and supplements. Some examples
- 25 have already been given earlier within this specification.

Preparations Intended for Primary Usage as Fertilisers

- Table 2 is a typical analysis for a 'mineralised' fertiliser product. Due to variations in the nature of the feedstock and plant matter, these values may vary and should be treated as being only representative of a typical production run.

Example 2a**TABLE 2**

	Nitrogen	3.7%	Boron	2600 ppm
	Phosphorus	3.00%	Iron	465 ppm
	Potassium	3.75%	Manganese	3795 ppm
10	Calcium	0.80%	Copper	1600 ppm
	Magnesium	0.50%	Zinc	2700 ppm
	Sodium	0.26%	Molybdenum	<0.50 ppm
	Sulphur	4.50%	Cobalt	500 ppm
	Iodine	1.75 ppm	Selenium	1.2 ppm

- 15 An example of the preparation of a mineralised preparation, such as characterised in Table 2 is as follows:

200 l base piscine liquid nutrient composition (such as characterised in Table 1)

	3.6 kg	magnesium sulphate
20	3.6 kg	"Solubor" timber preservative preparation
	1.6 kg	Copper sulphate
	3.6 kg	zinc sulphate
	0.8 kg	cobalt sulphate
	3.0 kg	manganese sulphate
25	5.0 kg	mono potassium sulphate
	5.0 kg	ammonium sulphate

Example 2b

- Where a high nitrogen, phosphorous or potassium deficiency has been diagnosed in a pasture or plantation or where a high N.P.K. product is required, the levels may be increased to that of the typical 'high N.P.K.' product analysis shown in Table 3. Due to variations in the nature of the feedstock and plant matter, these values may vary and should be treated as being only representative of a typical production run.

	Nitrogen	9%	Boron	2600 ppm
	Phosphorus	3.56%	Iron	306 ppm
10	Potassium	4.70%	Manganese	3795 ppm
	Calcium	0.70%	Copper	1600 ppm
	Magnesium	0.50%	Zinc	656 ppm
	Sodium	0.55%	Molybdenum	0.50 ppm
	Sulphur	4.5%	Cobalt	500 ppm
15	Iodine	1.75 ppm	Selenium	1.2 ppm

TABLE 3

Application of Fertiliser Preparations

Such base or fortified products may be applied directly to plants, pasture etc. Typical application rates for undiluted product are typically:

- 20 For pasture carrying sheep, 15 - 25 litres/ha. (for the high N.P.K product this may be reduced to 10 litres/ha.

For pasture carrying dairy cattle, 25 - 30 litres/ha. (for the high N.P.K. product this may be reduced by 50%)

- 25 For orchards, 50 - 100 litres/ha. (for the high N.P.K. product this may be reduced to 20 litres/ha.

Typically when sprayed, a fertilising composition is prepared which comprises one of the aforementioned products in combination with an acceptable carrier or diluent, normally water. The quantity of carrier is often determined by the nature of the spray equipment. The majority of
5 spray equipment is unable to achieve the low dosage rates required and thus dilution with a carrier is necessary. Also effecting the dilution are the requirements of the pasture or plantation, i.e. is the application merely a supplementary dressing or required to dose a deficient soil. Typically a fertiliser composition will comprise 0.1% - 50% of product (though the
10 viscosity of the product may influence the exact amount) diluted with water to a total of 100%. Ratios outside of this range are also envisaged.

Variations of Preparations Intended for Primary Usage as Fertilisers

A further fertilising preparation may also be prepared through the addition of an additional elemental fertiliser source to a fertilising
15 preparation such as previously described. In such a case it is typical for fertilising sources to be added to counter diagnosed deficiencies in the intended pasture etc. For instance, the specific level of boron may be increased through of the addition of a boron rich compound. Similarly for any other elements. This enables the customising of a fertiliser
20 preparation to individual pastures or intended application areas while using the same base (or fortified) product.

Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto without departing from the scope thereof as defined in the
25 appended claims.

WHAT WE CLAIM IS:

1. A process for the preparation of a liquid nutrient composition from a feedstock which is substantially fish or other marine derived matter, and plant matter comprising substantially seaweed; the process comprising steps of alkaline, and acid, treatment and wherein:
 - at least the plant matter is subjected to alkaline treatment, and
 - at least the feedstock is subjected to acid treatment.
2. A process as claimed in claim 1 in which said seaweed comprises kelp.
3. A process as claimed in claim 1 in which said plant matter is treated separately under alkaline conditions before its combination with said feedstock.
4. A process as claimed in claim 3 wherein alkaline plant matter is combined with said feedstock and the combination continues to be treated under alkaline conditions.
5. A process as claimed in either claim 1 or claim 2 in which plant matter is introduced, prior to its alkaline treatment, to said feedstock and the combination of feedstock and plant matter is subsequently treated under alkaline conditions.
6. A process as claimed in either claim 1 or claim 2 in which the feedstock is treated separately under alkaline conditions, and the plant matter is combined with the feedstock while it is still subjected to the alkaline conditions.



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7. A process as claimed in either claim 1 or claim 2 in which plant matter is introduced, prior to its being treated under alkaline conditions, to alkaline treated feedstock and wherein said combination continues to be treated under alkaline conditions.
8. A process as claimed in any one of the preceding claims in which alkaline treatment comprises allowing a period of time to elapse under conditions which are achieved by the incorporation of at least one of the following alkaline agents: alkali metal oxides, alkali metal hydroxides, alkali metal carbonates, alkaline earth metal oxides, alkaline earth metal hydroxides, and alkaline earth metal carbonates.
9. A process as claimed in claim 8 in which a selected alkaline agent includes sodium hydroxide or potassium hydroxide.
10. A process as claimed in either claim 8 or claim 9 in which said alkaline agent is soluble and introduced as a solution.
11. A process as claimed in any one of claims 8 through 10 in which the amount of alkaline agent introduced is 0.5 - 1.0%, by weight, of the resulting mixture to which it has been introduced.
12. A process as claimed in either claim 1 or claim 2 in which treating the feedstock in acid conditions occurs, or is initiated, before the introduction of said plant matter.
13. A process as claimed in either claim 1 or claim 2 in which substantially the entire combination of feedstock and plant matter is treated under acidic conditions.



14. A process as claimed in any one of the preceding claims in which treating the feedstock under acid conditions comprises allowing a period of time to elapse after the introduction of at least one acidic compound, and wherein sufficient acidic material is introduced to lower the pH, initially, to 3.5 or less.
15. A process as claimed in claim 14 in which sulphuric acid is introduced to the feedstock.
16. A process as claimed in any one of the preceding claims in which at least said feedstock remains in acidic conditions for approximately 3 weeks.
17. A process as claimed in any one of the preceding claims in which said feedstock is occasionally agitated during treatment under acidic conditions.
18. A process as claimed in any one of the preceding claims which includes a comminution step.
19. A process as claimed in claim 18 in which a comminution step comprises at least one of the following:
 - comminution of said feedstock prior to treatment under acid conditions;
 - comminution of said plant matter prior to treatment under alkaline conditions;
 - comminution of combined feedstock and plant matter;
 - comminution of said feedstock after treatment under acid conditions, and
 - comminution of said plant matter after treatment under alkaline conditions.



20. A process as claimed in any one of the preceding claims which includes a screening step to remove unliquefied solid matter.
21. A process as claimed in any one of the preceding claims which includes an oil separation step.
22. A process as claimed in any one of the preceding claims in which the process is maintained, during treatment of the feedstock under acidic conditions, at a temperature not exceeding 50°C.
23. A process as claimed in claim 22 in which said process is maintained, during treatment of the feedstock under acidic conditions, at an average temperature of 25°C or greater.
24. A process as claimed in any one of the preceding claims which includes a step comprising the addition of at least one additional elemental fertiliser source, as herein defined.
25. A process for the preparation of a liquid nutrient composition from plant matter comprising substantially seaweed, in combination with a feedstock which is substantially matter derived from fish, cetaceans, molluscs, and/or crustaceans, said process being substantially as described herein with reference to example 2.
26. A liquid nutrient composition, when prepared according to a process as claimed in any one of claims 1 through 24.
27. A thickened liquid nutrient composition, when prepared according to a process as claimed in any one of claims 1 through 24 and in which said plant matter comprises a seaweed having viscosity increasing characteristics.



28. A thickened liquid nutrient composition as claimed in claim 27 which is a gel.
29. A composition as claimed in any one of claims 26 through 28, in which the feedstock comprises fish material derived from Orange Roughy and/or Cardinal.
30. A composition as claimed in any one of claims 26 through 29, which includes added trace elements.
31. A liquid nutrient composition, substantially as described herein with reference to the example 2.
32. A thickened liquid nutrient composition, substantially as described herein with reference to the example 2.
33. A process for the preparation of a fertiliser composition comprising the addition of a diluent or carrier to a composition as claimed in any one of claims 26 through 30.
34. A process for the preparation of a fertiliser composition comprising the addition of at least one additional elemental fertiliser source, as herein defined, to a composition as claimed in any one of claims 26 through 29.
35. A fertiliser composition, substantially as described herein with reference to the example 2.
36. A method of fertilising plants comprising the application of a composition as claimed in any one of claims 26 through 30.
37. A method of fertilising plants comprising the application of a fertiliser composition prepared by a process as claimed in either claim 33 or claim 34.



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38. A method for the planting of seeds comprising their dispersal in a thickened liquid nutrient composition as claimed in either claim 27 or claim 28, and the subsequent application of same into the soil or seed drill.

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